CHAPTER 3
DEMAND FOR HEALTH: THE GROSSMAN MODEL

Intro

- Previously…
  - Demand for health care is downward sloping
  - People choose amount of health care they receive based on price
- People choose their health care, but do they choose their own health?
  - Is health something that happens to us? Or do we choose it?
  - We use the Grossman model to explore this question

The 3 Roles of Health (H)

Health plays three roles in the Grossman model:

1. A consumption good
2. An input into production
3. A form of stock/capital (an investment)

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Health as a consumption good

Health as a direct input into utility

- Health as a consumption good enters **directly** into utility
- Single-period Utility at time *t*

$$U_t = U(H_t, Z_t)$$

  - H_t = level of health
  - Z_t= "home good"
    - Everything non-health that contributes to utility
    - E.g. video games, time with friends, movie tickets

**Note: health ≠ health care

  - Health *care* is not explicitly in the utility function
    - i.e. Getting vaccines does not provide utility but staying healthy does

Time constraints in the Grossman model

- In a single period, there are only 24 hours in a day to contribute to your utility:

$$\Theta = 24 = T^W + T^Z + T^H + T^S$$

- Divide total time Θ between:
  - Working T^W
  - Playing T^Z
  - Improving health T^H
  - Being sick T^S

Time constraint means time tradeoffs

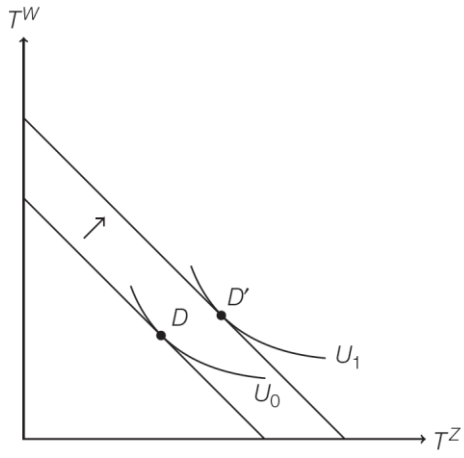
- Time working T^W produces income
  - Buy things that contribute to utility (H, Z) but need to spend time in those activities (T^H, T^Z)
- Time sick T^S does not increase utility
  - Every hour spent sick takes away time to do other utility-increasing activities (loss time)

Table 3.1. *Activities in the Grossman model.*

Activity	Example	Purpose
Working (T^W)	Working at a power plant; playing professional sports; teaching health economics	Earn income to purchase items that will enhance H and Z
Playing (T^Z)	Doing a jigsaw puzzle; going to the opera; logging onto Facebook	Enhance Z
Improving health (T^H)	Jogging; undergoing surgery; beauty rest	Enhance H
Being sick (T^S)	Spending the day home in bed, doing nothing	None; T^S is always wasted time

The labor-leisure tradeoff

- Given levels of T^S and T^H, individual chooses how to allocate time between work T^W and play T^Z.
- Optimal point decides on indifference curves
- When health improves, more productive time is available for use
  - Pushes time constraint outward (from U_0 to U_1)
  - Can reach higher utilities



Health as an input into production

The three roles of health (H)

Health plays three roles in the Grossman model:

1. A consumption good
2. An input into production
   - Of health (H)
   - Of productive time (T^P)
3. A form of stock/capital (an investment)

Producing H and Z

Both Health and Home good Z must be **produced** with time and market inputs

$$H_t = H\,(H_{t-1}, T_t^H, M_t)$$
$$Z_t = Z\,(T_t^Z, J_t)$$

- M_t= market inputs for health H
  - Ex: weights, treadmill
- J_t= market inputs for home goods Z
  - Ex: video games, opera tickets
- Today's health H_t also depends on yesterday's health H_{t-1}
  - This is health's third role as a stock which we discuss later

Health affects production by lowering T^S

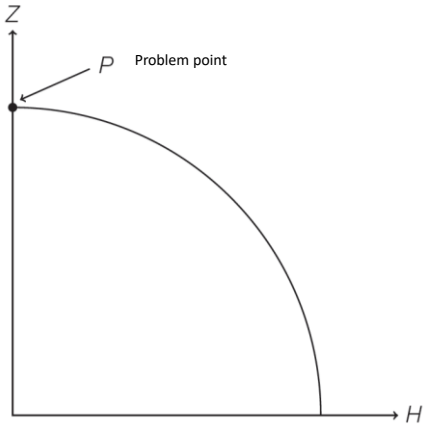
$$T^P = \Theta - T^S = T^W + T^Z + T^H$$

- Healthier you are, the less time you spend sick
- T^P is productive time spent on useful activities
  - Increased productive time can be reinvested into health (T^H) or other useful endeavors (T^W, T^Z)
- Only way to reduce sick time (T^S) is to improve health

Production Possibility Frontier

- **Production Possibility Frontier (PPF):** the possible combinations of H and Z attainable, given an individual's budget and time constraints
- Standard economic PPF shows H and Z as substitutes
  - Wrong! Why?
- Maximum Z is minimum H
  - If individual is at minimum H, they are dead and cannot produce any Z

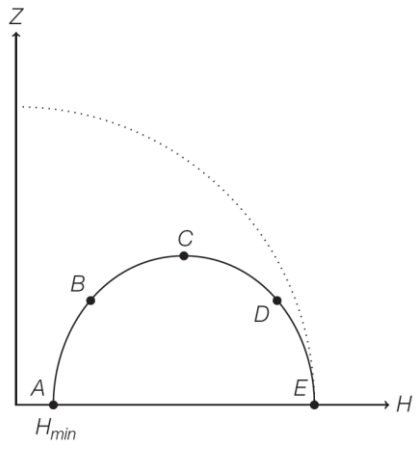
An **INCORRECT** PPF



PPF in the Grossman model

- Point A
  H_{min}: no productive time for work, play, or improvement of health
- Point B
  - **"free-lunch zone"**
  - Small improvements in health yield large increases in productive time; can increase Z without giving up H

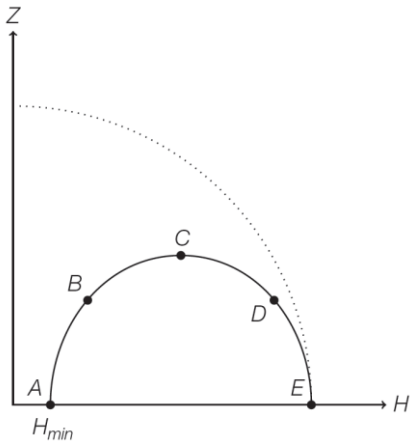
A **CORRECT** PPF



PPF in the Grossman model

- Point C
  - Maximum Z possible
  - Can't improve health without taking away Z
  - If try to increase Z by shifting resources, sick time will increase and outweigh gain in resources for Z
  - Increases in health will not produce extra time to offset time spent improving health

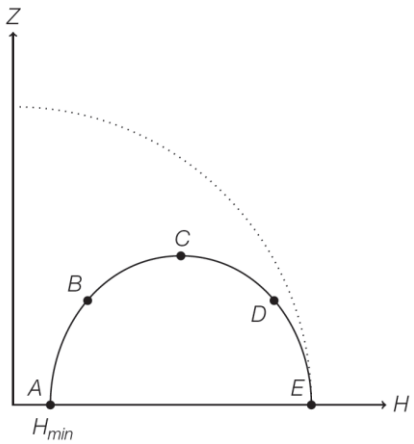
A **CORRECT** PPF



PPF in the Grossman model

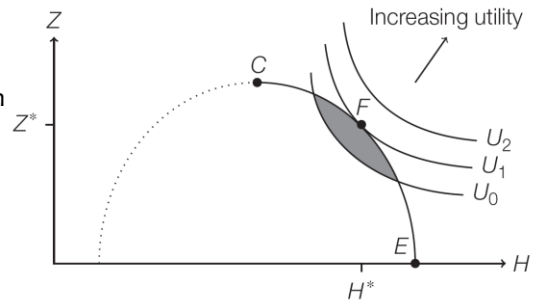
- Point D
  - **"tradeoff zone"**
  - Increases in H only yield small decreases in sick time
  - Increases in H, takes away from Z
- Point E
  - Spend all time and money on health
  - Ignores all home goods

A **CORRECT** PPF



Choosing optimal H* and Z*

- Someone who values both H and Z chooses a point between **C** and **E** in order to maximize their utility
- Chooses point F
  - U_2 is unattainable given PPF constraints
  - At U_0, an individual can attain more utility
  - At F: U_1 and PPF are tangent
  - H* and Z* are optimal levels of health and home goods



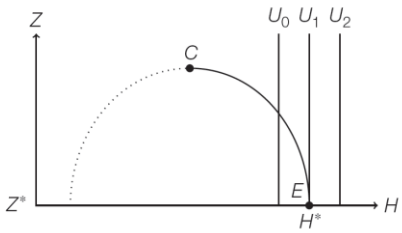
Exotic preferences and indifference curves

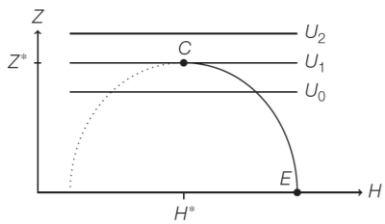
Cares only about Health H

- If individual only cares about Health
  - Vertical indifference curves
  - H* and Z* at point E

Cares only about home good Z

- If individual only cares about home goods (Z)
  - Horizontal indifference curves
  - H* and Z* at point C





Health as an investment

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Lifetime of utility

- On any day, an individual considers not only *today's* utility $U(H_0,Z_0)$ but all *future* utility as well!

$$U = U(H_0,Z_0) + \delta U(H_1,Z_1) + \delta^2 U(H_2,Z_2) + \cdots + \delta^{\Omega} U(H_{\Omega},Z_{\Omega})$$

$$= \sum_{t=0}^{\Omega} \delta^t U(H_t,Z_t)$$

- Health is a **stock**; some of it carries over each new period
  - Home good Z is a **flow** (it lasts for only 1 period)
- δ = individual's discount rate
  - A person values utility now more than in the future
- Ω = individual's lifespan (total number of periods)

Health depreciates over time

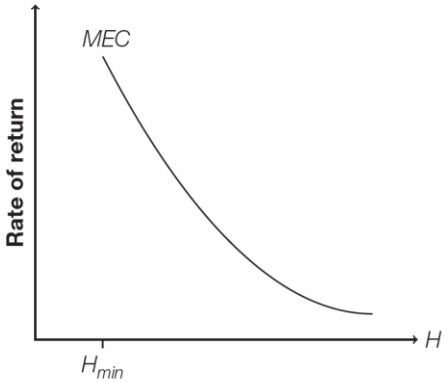
Some of yesterday's health lasts to today but not all of it

$$H_t = H\left((1-\gamma)H_{t-1}, T_t^H, M_t\right)$$

- γ = rate of depreciation
- Recall:
  - H_t = health at time period t
  - H_{t-1} = health from previous period
  - T_t^H = time spent on health in period t
  - M_t = market inputs for health (like checkups and prescription pills)

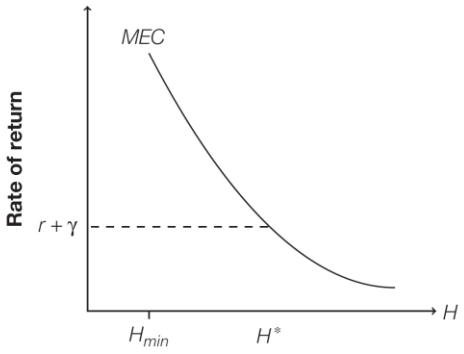
MEC curve and investments in health

- **Marginal Efficiency of Capital (MEC) curve:** indicates how efficient each unit of health capital is in increasing lifetime utility
- When level of H is low, small investments have high returns to productive time



Costs to investing in health

- **Opportunity cost**
  - Forgoes putting money into other investments
  - r = interest rate of alternative market investment
- **Depreciation** due to aging (γ)
  - Health must pay a return of at least r + γ
  - If return is less than r + γ, then market return beats health investment return
- H* = optimal amount of health
  - Marginal cost balances with marginal benefit of health investment



Predictions of the Grossman model

The Grossman model helps explain why we observe:

1. Better health among the educated
2. Declining health among the aging

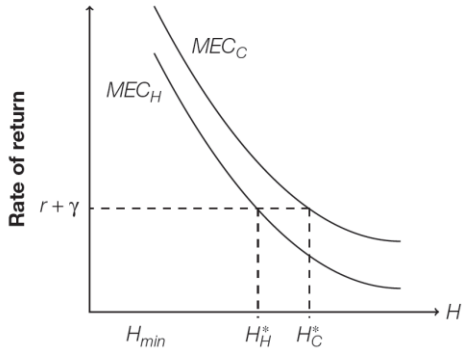
Health and education

- Well-educated individuals are more efficient producers of health
  - College grads benefits more than a high school dropout.
  - Explanations?

MEC and efficiency of health investment

Better educated are *more efficient* at each level of health investment

- $MEC_C > MEC_H$
- H^*_C is higher than H^*_H



- MEC_C = college graduate
- MEC_H = high school dropout

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Predictions of the Grossman model

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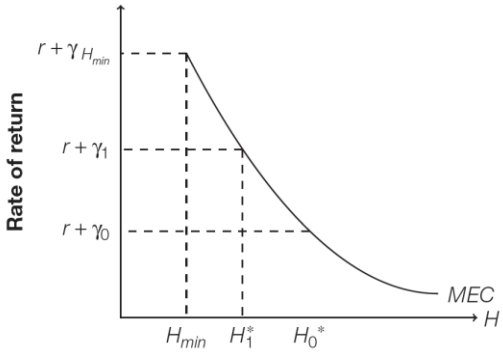
Depreciation of health

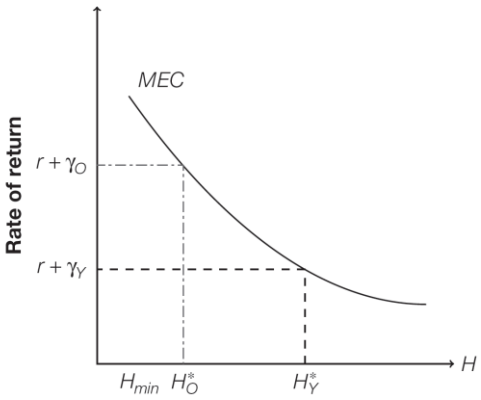
- Recall:

  $H_t = H\left((1-\gamma)H_{t-1}, T_t^H, M_t \right)$
- Depreciation γ is **not** constant
- γ increases with age
- As γ increases, costs $(r + \gamma)$ increase and it takes more resources to maintain same level of health



As a result of increasing depreciation *γ* over time, optimal health H* also declines over time!

Optimal death in the Grossman model



- Because of rising depreciation, there are better investments in the market than the individual's health
- H* eventually reaches H_{min}
- Why would anyone choose H_{min}?
  - How is H_{min} utility-maximizing?

Conclusion

- Is health something that happens to us or is chosen?
  - Grossman model says it is *chosen*
  - In fact, we even ***choose*** when we die
  - While that may seem far-fetched, Grossman model a useful tool for understanding the roles and tradeoffs of health
- Next we use the Grossman model to understand empirical findings about the relationship between socioeconomic status and health